Effective Characterization Technologies

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Successful Cleanup Actions or Monitoring Depends on An Accurate CSM

What is a Conceptual Site Model?

A CSM is any tool(s) that lets you represent, "conceptualize" or "model" site contamination issues and concentration populations so you can make predictions about nature, extent, risk, and risk reduction strategies

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project constraints?

Project constraints: costs, time, desired/preferred site reuse/project outcome

Stated another way…

A CSM represents your best estimate for

- where the contamination is
- what is happening to it
- how someone or something might be exposed, and
- what you are going to do to stop any unacceptable exposures.

To make good project decisions, build a more accurate CSM!

To develop a more accurate CSM, you need data from the site.

The Triad approach is a framework for integrating modern data generation technologies with efficient work strategies so CSMs can be built "faster, cheaper, and better."

Just 2 examples of these technologies are presented.

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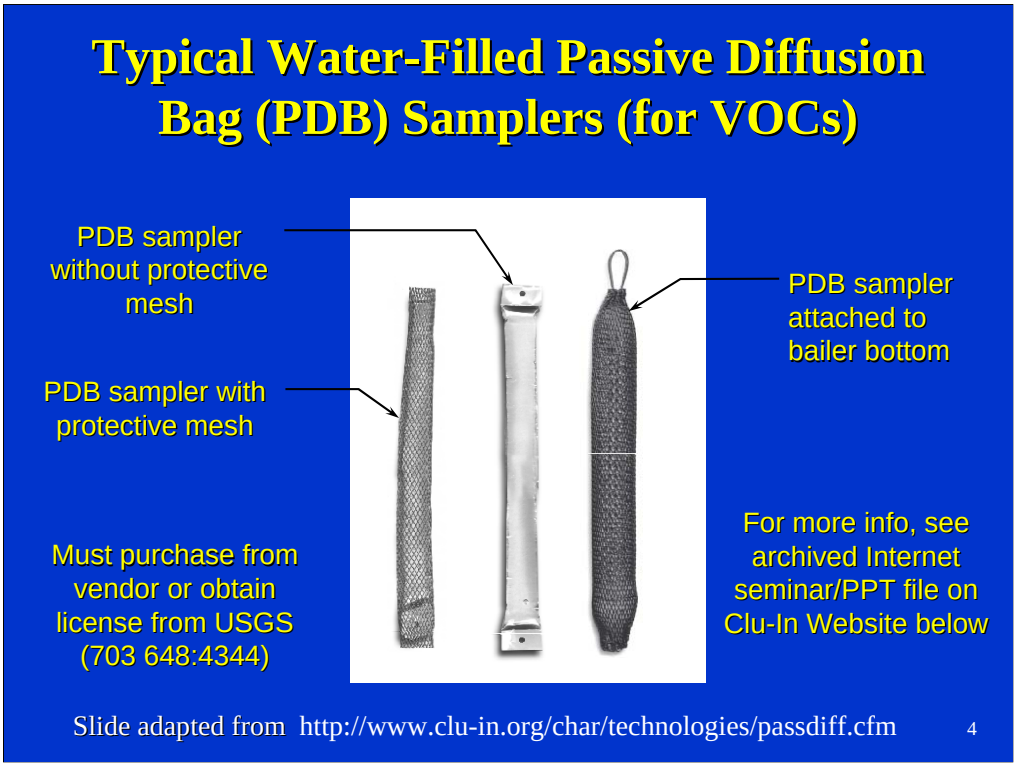
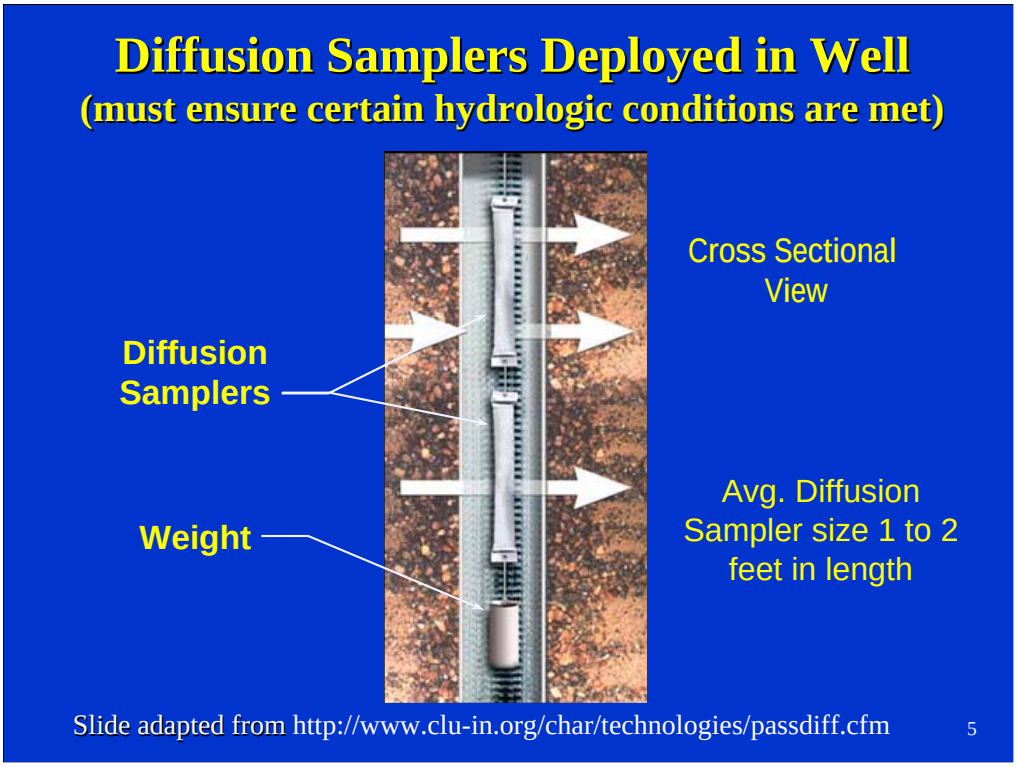


Passive Diffusion Bag (PDB) samplers consist of a low-density polyethylene sleeve, filled with laboratory-grade deionized water, and closed at both ends. Pictured here are three types of diffusion samplers commonly used and commercially available. The samplers on the left are supplied prefilled with laboratory-grade deionized water, and the sampler on the right is field-fillable. PDB samplers employ patented technology (U.S. patent number 5,804,743), and therefore, require that the user purchase commercially produced samplers from a licensed manufacturer or purchase a non-exclusive license for sampler construction from the U.S. Geological Survey Technology Enterprise Office, Mail Stop 211, National Center, 12201 Sunrise Valley Drive, Reston, Virginia 20192 (telephone 703 648-4344; fax 703 648-4408).



That is where the diffusion samplers come in. PDB samplers are deployed in the screened interval and allowed to equilibrate. After sufficient equilibration, the samplers are removed and the enclosed water is transferred to volatile organic analysis (VOA) vials. Thereafter, the samples are treated as ordinary VOA samples.

Uncontrolled Blurring of Distinct Populations Produces Inaccurate CSMs

same well field…2 different sample collection techniques

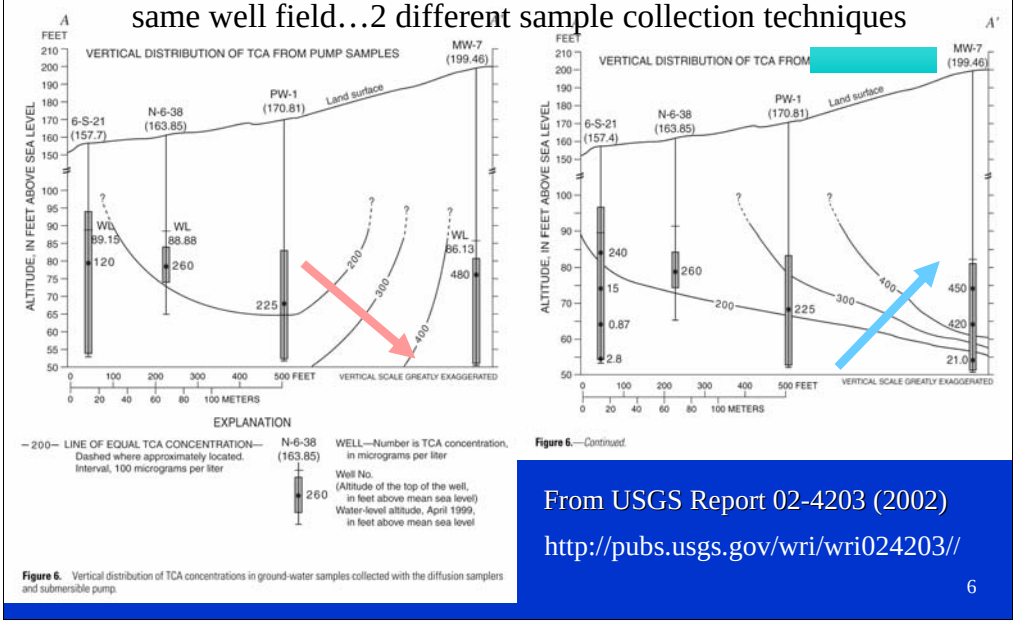


Figure 6. Vertical distribution of TCA concentrations in ground-water samples collected with the diffusion samplers and submersible pump.

Figure 6.—Continued.

From USGS Report 02-4203 (2002)

http://pubs.usgs.gov/wri/wri024203//

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Huffman, R.L. (2002) Comparison of Passive Diffusion Bag Samplers and Submersible Pump Sampling Methods for Monitoring Volatile Organic Compounds in Ground Water at Area 6, Naval Air Station Whidbey Island, Washington. U.S. Geological Survey Water-Resources Investigations Report 02-4203. Available on-line at http://pubs.usgs.gov/wri/wri024203/

CSM based on traditional sampling is very different from CSM based on more detailed, spatially accurate sampling.

Passive Diffusion Samplers Preserve Any Vertical Concentration Gradients in the Well

From USGS Report 02-4203 (2002)

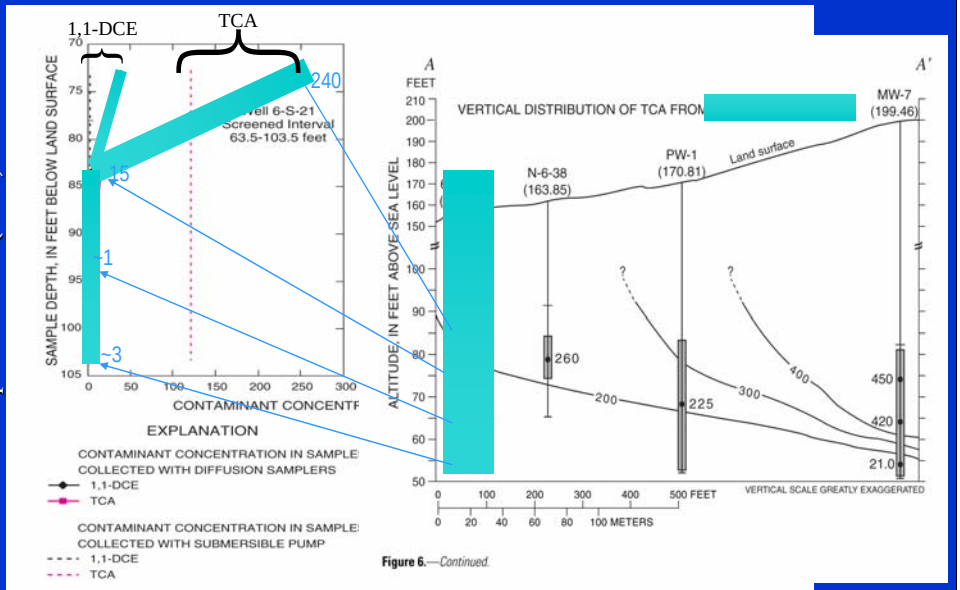

Figure 5. Comparison of selected volatile organic compound concentrations from ground-water samples collected with diffusion samplers and a submersible pump for wells with greater than 20-foot screened intervals in Area 6, Naval Air Station Whidbey Island, Washington.

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Huffman, R.L. (2002) Comparison of Passive Diffusion Bag Samplers and Submersible Pump Sampling Methods for Monitoring Volatile Organic Compounds in Ground Water at Area 6, Naval Air Station Whidbey Island, Washington. U.S. Geological Survey Water-Resources Investigations Report 02-4203. Available on-line at http://pubs.usgs.gov/wri/wri024203/

Membrane Interface Probes (MIPs, for VOCs)

Multiple Platforms for Deployment

- **Direct push rigs (small trucks)**
- **CPT units (large 20-ton trucks)**
- **Drill rigs**

- **Waterborne**
- **All-terrain track**
- **Indoor or limited access**

Slide adapted from Columbia Technologies, Inc., 2003

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Direct Sensing Module

Slide adapted from Columbia Technologies, Inc., 2003

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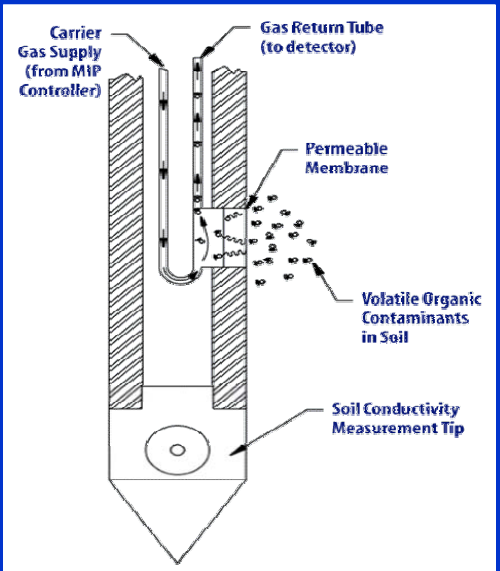
MIP Principles of Operation



- Heated probe
- Semi-permeable membrane
- Contaminant vapors "filtered" into carrier gas
- Transported to FID, PID, ECD &/or MS detectors at the surface
- Results are displayed in real-time on a lap-top computer.
- Go to clu-in.org

Slide adapted from Columbia Technologies, Inc., 2001

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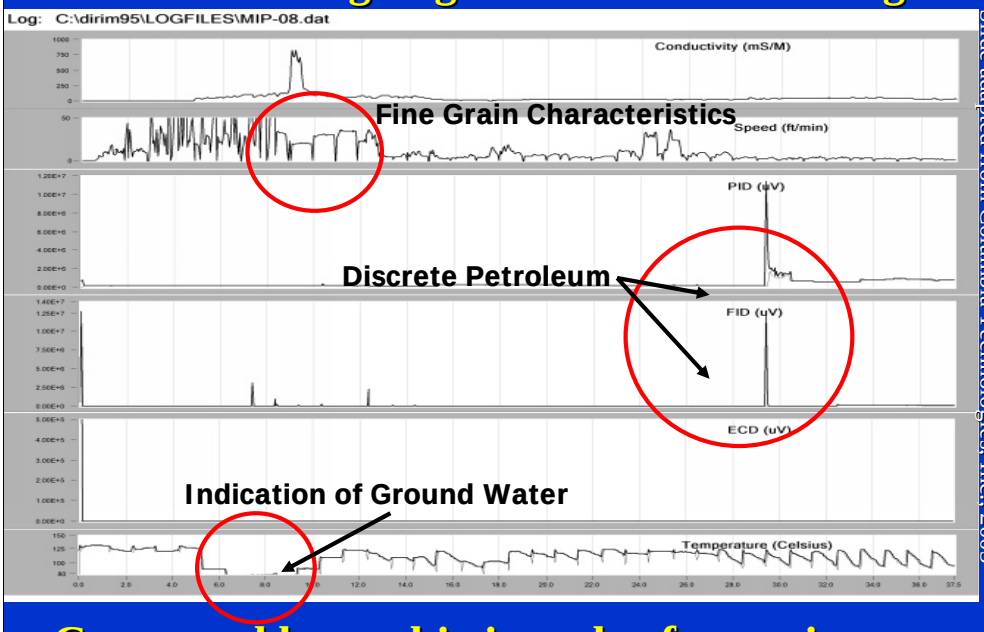
Direct Sensing Logs: Raw Data as Tracings



Slide adapted from Columbia Technologies, Inc., 2003

Converted by sophisticated software into…

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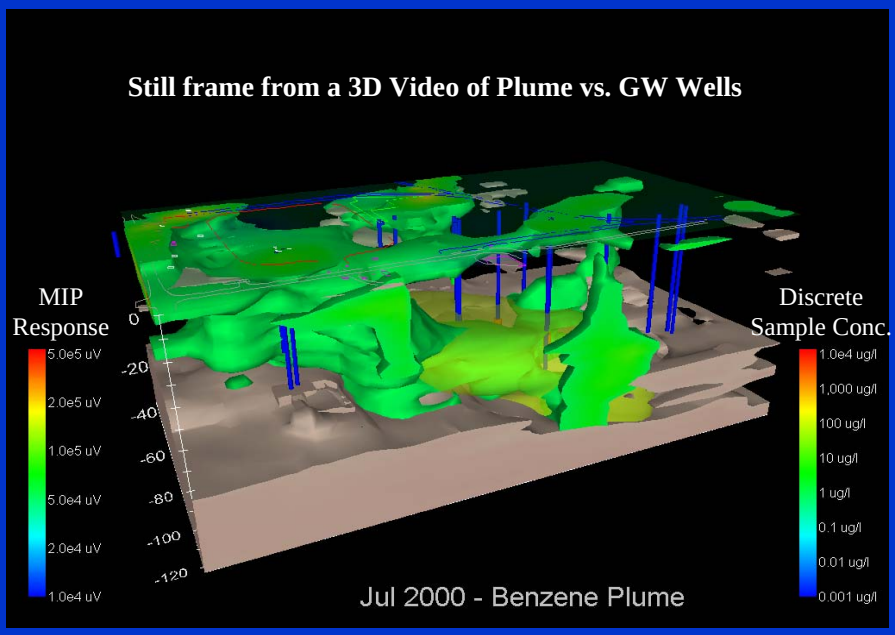
…a 3-D View of the CSM



Slide adapted from Columbia Technologies, Inc., 2003

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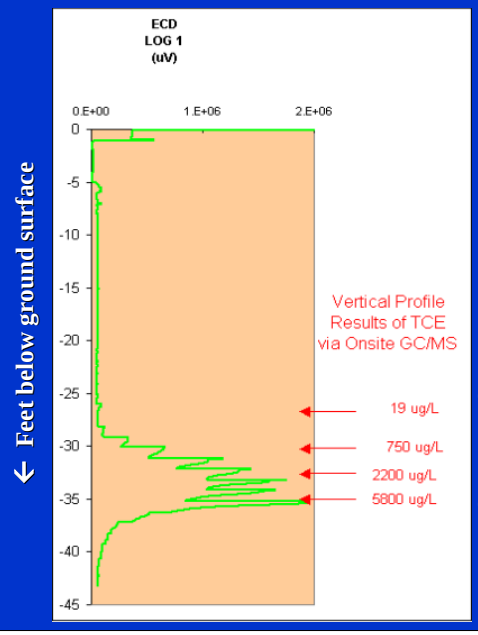
What the technology is capable of in the hands of a sophisticated user.

The MIP Helps "Image" the Location and Relative Concentration of Subsurface VOC Contamination



MIP/ECD relative response (in microvolts) traced against depth for the TCE contaminant.

MIP relative response correlated with results of depth-discrete samples

Graphic courtesy of Columbia Technologies

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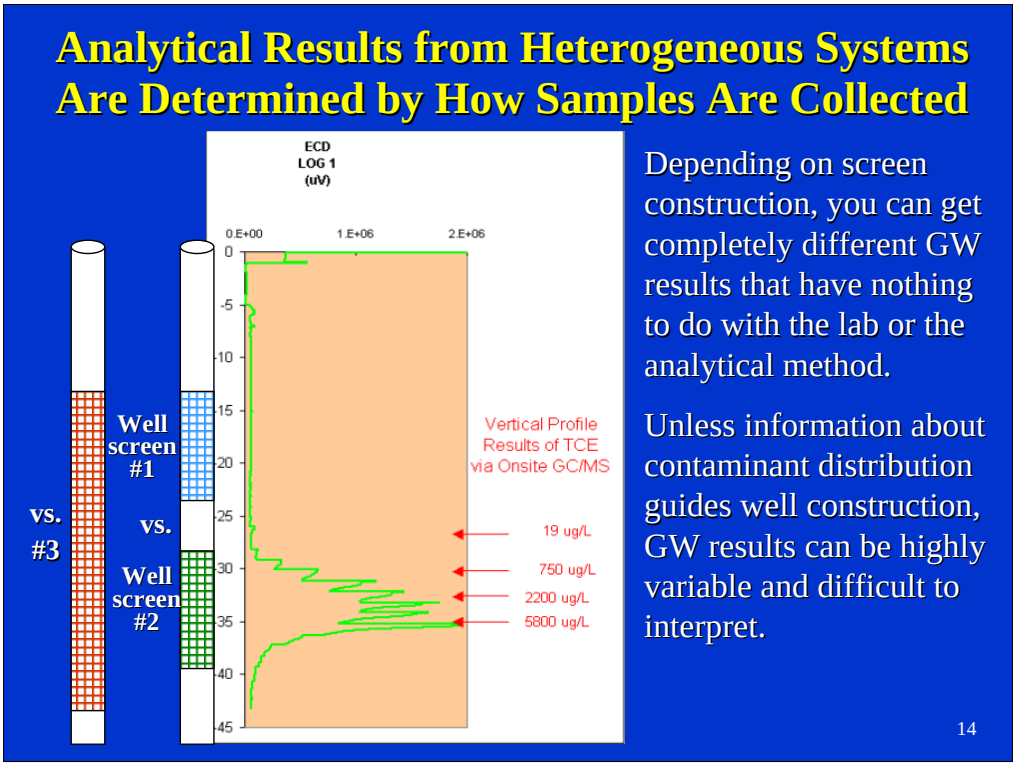
Direct-push MIP-ECD taking readings every 2 inches going down to create a vertical profile of contamination in the subsurface.

Soil conductivity results suggest transitions from sandy matrix to clay matrix (higher conductivity in clayey soil). The 7- to 8-ft wide band of contamination is associated with a clay layer in the subsurface. Small, discrete GW samples (i.e., very small sample support) representative of point concentrations were collected using the DP probe and analyzed using GC-MS. The results allow coarse calibration (in units of ug/L = mass TCE per volume of GW) of the magnitude of the ECD response (in voltage units).

What analytical results (low, medium, or high lab results) would be expected if a monitoring well were screened over the various intervals in the animation graphic? (Keep in mind that clay layers may be rather non-permeable to water flow as compared to sandier layers.)



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Display Options: 2-D Representation of a CSM

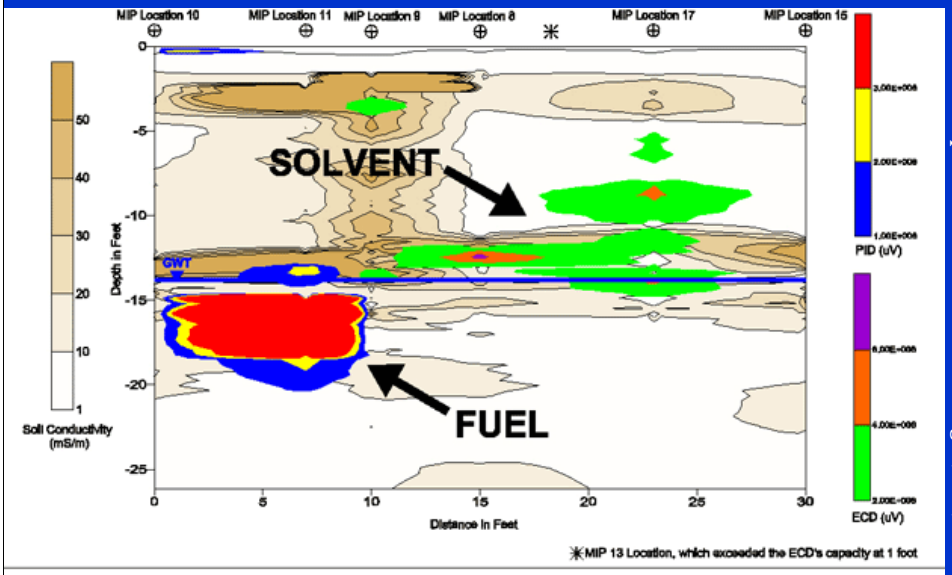

Figure 1
PID & ECD Response Transect
Dry Cleaner Site
January 30-31, 2001, February 1, 2001

COLUMBIA TECHNOLOGIES

Slide adapted from Columbia Technologies, Inc., 2001

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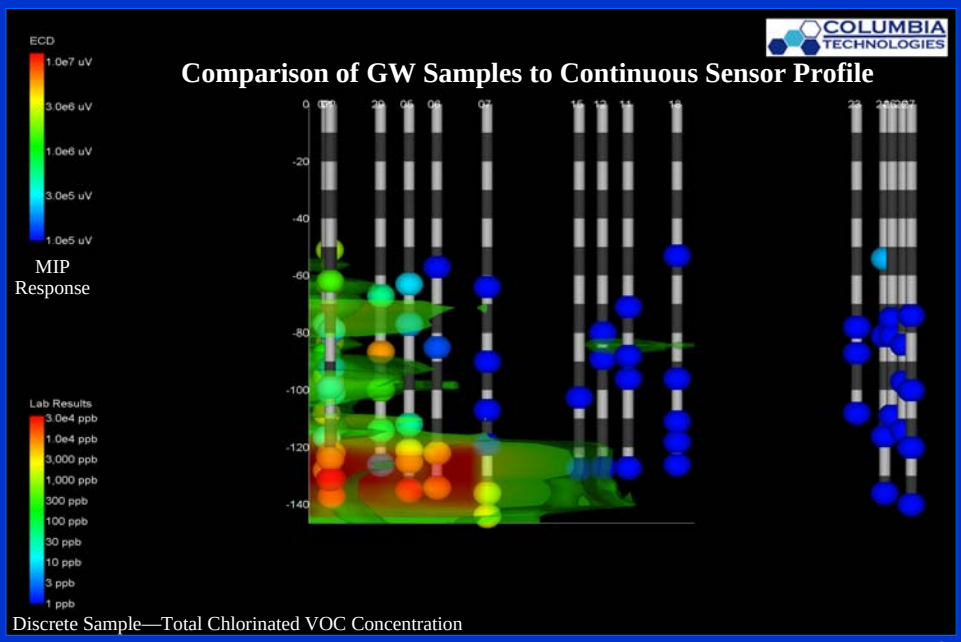
Display Options: Include Discrete Sample Results



Discrete Sample—Total Chlorinated VOC Concentration

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SMART DATA OUTPUTS

- Built to client specifications
- Interactive 3D
- Easy to view correlation between various data sets

Additional Information

Membrane Interface Probe information

- Through Field Analytics Encyclopedia website http://www.clu-in.org
  - –http://www.clu-in.org/char/technologies/mip.cfm

Passive Diffusion Samplers information

- Through ITRC website http://www.itrcweb.org
  - http://diffusionsampler.itrcweb.org/common/default.asp

Related information

- EPA TIO's Clu-In website for Triad http://cluin.org/triad
  - Assorted sampling information: http://cluin.org/char1_edu.cfm#samp_coll and http://cluin.org/char1_edu.cfm#stat_samp
  - Archived Triad seminar: http://www.triadcentral.org/news/dsp_archive.cfm
- USACE Engineering Manuals (EMs)

http://www,usace.army.mil/publications/eng-manuals

US Army Corps CSM Guidance EM: EM 1110-1-1200

– US Army Corps TPP Guidance EM: EM 200-1-2

- USACE CRREL Technical Report Library

http://www.crrel.usace.army.mil/products/products.html

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